THE AMERICAN
JOURNAL OF PHARMACY

VOL. 108 DECEMBER, 1936 NO. 12

EDITORIAL

SCIENCE AND MIRACLES

"Every experiment opens new trends
Each with beginnings—not ends."

THE hostility which the great experiment in Russia seems to bear toward all religion is a challenge to God-believers of every creed and nation.

The program which the Soviet government has planned for the extinction of religion within its jurisdiction is in some ways as ludicrous as it is pathetic. And the most ludicrous phase of it all is the attempt to discredit the traditional miracles of the several religions by giving them an alleged scientific explanation, upon the assumption that a religion with "exploded" miracles is no religion at all.

Their "instructors in atheism" lecture to "Godless societies" at "anti-religious museums" and part of their scheme is to actually duplicate, by chemical means, in sight of their audiences, the so-called miracles of religion.

Emphasis is laid on the "fact" that chemistry is older than most religions, that Hermes preceded Christ and Thoth lived ahead of Mohamet. The naive argument is then, that most of the miracles were chemical tricks perpetrated by privileged priests just to confound and impress an impressionable people.

Such an explanation is calculated to make some impression on the uncultivated Soviet masses, or at least to awaken a positive interest for the anti-religious propaganda to follow. It is assumed that the masses have little interest in earnest discussions, but seek rather conversation and entertainment. Upon this basis the experiments are led through a definite sequence and made as entertaining as possible. Some of the experiments are briefly as follows:

THE SELF-IGNITING CANDLES. To explain this miracle, the wick of a tallow candle is moistened, by means of a pipet, with a suspension of yellow phosphorus in carbon disulfide. After a few moments the candle wick ignites and the miracle of the self-igniting candles in the Church of the Holy Sepulchre in Jerusalem is imitated! The demonstrator reasons that the candles were not ignited by divine fire summoned by the prayers of Easter pilgrims, and that the experiment "reveals" one of the "tricks" of the Jerusalem priests. This "revelation" is apparently successful. It is then explained that the evaporation of the disulfite solution deposits finely divided yellow phosphorus which combines vigorously with air at room temperature and that the candle wick is thus ignited.

THE OFFERING FIRE. In order to demonstrate that "fervent prayer is not required to summon divine fire by which the offering is ignited," some potassium permanganate in a porcelain dish is moistened with sulfuric acid and the dish concealed in a mimic, sacrificial altar. Wood shavings—the "offering"—will then be carefully laid on a wire triangle placed over the dish! The demonstrator, with a few spoken "magic formulas," "blesses" the "offering" with his hands and the sacrifice bursts into smoking flame! The demonstrator then explains how this was accomplished. A wad of cotton saturated with alcohol was held in the hand and drops of alcohol were pressed out at the operator's convenience to fall upon the chemicals in the dish. The reaction of potassium permanganate and sulfuric acid releases active oxygen, which oxidizes the alcohol. Enough heat is evolved to kindle the alcohol and also the shavings.

THE DIVINE PICTURE. Some monasteries have tapestries which are asserted to have the miraculous power of reproducing holy images when washed and dried by a monk. In the experiment "exposing" this miracle the operator selects a suitable piece of cloth upon which the barely visible outline of some holy figure is sketched in pencil. The colorless solutions of cadmium sulfate, bismuth subnitrate, manganous chloride, and lead acetate are applied to the cloth with a brush and allowed to dry. The cloth is then apparently unchanged. By means of an atomizer a solution of sodium sulfide is sprayed upon the cloth, and the "not by human hand" holy picture is brought out in bright colors! The demonstrator then explains the reaction of the salts applied to the cloth with sodium sulfide to form the insoluble metallic sulfides—namely, the yellow cadmium sulfide, the brown

bismuth sulfide, the flesh-colored manganese sulfide, and the almost black lead sulfide.

THE FLAMING CHARACTERS ON THE WALL. In explanation of this miracle certain characters are brushed on a dark-colored board with a dilute suspension of yellow phosphorus in carbon disulfide. When the lights in the hall are extinguished the message stands out in letters of fire. The message was "mene tekel upharsin,"[1] the words of the Biblical handwriting on the wall, which alarmed the Babylonian King Belshazzar and were interpreted by the prophet Daniel as a divine exhortation against the king's acts. The miracle of the writing on the wall is thus explained to rest upon the property of yellow phosphorus to phosphoresce in the dark.

THE VANISHING CROSS. Another miracle recorded by religion is the vanishing of various religious objects. The demonstrator casts a metal cross into a glass of water which is covered by a paper screen. When the screen is removed the cross has vanished! The explanation follows that the cross was made of Wood's metal (bismuth, 4 parts; lead, 2 parts; tin and cadmium, 1 part each; melting point, 70° C.), and the temperature of the water was high enough to melt it, the alloy sinking to the bottom like so much quicksilver.

THE MIRACLE OF HEALING WOUNDS. To reproduce this miracle a volunteer is summoned from the audience and is asked to bare his arm. The demonstrator disinfects the skin with a moist wad of cotton and with a knife apparently cuts several lateral incisions. Blood appears to flow from the wounds, which are quickly covered with a hand towel. After several "magic formulas" are said the towel is removed and the wounds have vanished! The explanation is that the wad of cotton was saturated with ammonium sulfocyanide and the knife was treated with ferric chloride solution. The "blood" was only blood-red ferric sulfocyanide.

Many more experiments similar to the six mentioned are performed in the interest of anti-religious propaganda, a few of which are the transformation of water to milk, with barium chloride and sodium sulfate; the pillar of cloud—with hydrochloric acid and ammonia; the transformation of water into wine, with aqueous solutions of phenolphthalein and sodium hydroxide; the transformation of water into blood—one of the seven Egyptian plagues—with solutions of ammonium sulfocyanide and ferric chloride.

[1] Babylonian meaning *counted, weighed, and found wanting.*

The number of such experiments could be extended practically without limit but these should be sufficient to illustrate how Russian science is used in the service of anti-religious propaganda. Ultimately the leaders of the project, who are hardly more than magicians, with about the same chemical skill, expect to attain their goal. One who has had the opportunity to be present at an anti-religious experiment lecture, whether in the city or in some remote Russian village, will be convinced that this is so; religious belief, shaken seriously by the revolution, needs little encouragement to vanish utterly.

Thousands of the non-cultured attend these demonstrations and are amused to see religion refuted so entertainingly by science and chemistry.

That any modern government should tolerate as a means to any end, so quackish, so blatantly untruthful a technic as reflected in the above experiments, is incredible.

But it does suggest that the Soviet government will stoop to any method that promises the results desired.

It also memorializes another step in the *so-called* "forward march of Science," and justifies, for the present at least, these words of the poet:

"All of Philosophy's only a rhyme
And Science a vaporous wraith,
Man's only hope for a Conquest of Time
Is a simple reliance on Faith."

IVOR GRIFFITH.

NOTE: The facts, recorded in the foregoing editorial, are taken from an article reported in the News Edition of the *Journal of Ind. and Eng. Chemistry* (July 20, 1936), written by Rudolf Seiden and translated from the German by H. W. Peel, Jr.

SELECTED EDITORIAL

BIOLOGICAL ENGINEERING*†

RATHER a shock to the conservatives is this term chosen to cover a new field of activity in applied science. Biological engineering does not find its place in the index of the early works on biology, any more than did chemical engineering in chemistries of the period when chemist and test tube were almost synonymous. The combination marks another advance in applied science and in the fusion of all technology as the borders of each specialty are extended.

Although biological engineering has not reached that stage of maturity that would place it among the "disciplines" of the scholars, it is new only in a relative sense. It includes, for example, the use of electronic circuits for medical research, diagnosis and therapeutics generally. It includes food engineering and certain applications of public health engineering. Most obviously, it includes the large-scale manufacture of fermentation products, alcohol particularly.

These are but examples and it is yet too early to predict the limits within which the term will eventually crystallize if it follows the course of its predecessors from the patriarch, civil engineering, down to the lusty infant that is physical engineering. There are biological engineers in active commercial practice who have recognized and adopted the title in all seriousness. Engineers with Commercial Solvents Corporation, for example, have been so known for a number of years. They design and operate engineering equipment for the production of butyl alcohol and other solvents by fermentation. Problems of sterility, of pure cultures and the handling of media under proper conditions on a large scale involve biological engineering of the highest order, and it is actually in a well-advanced stage of development. The test tubes with which they experiment are fifty feet high. Recently official recognition of the term in academic circles has come with its use by the administrative staff of the Massachusetts Institute of Technology, as the most descriptive means of defining

* From *Industrial Bulletin* of Arthur D. Little, Inc., Cambridge, Mass.

†Of particular interest is this topic to readers of this JOURNAL, in view of the fact that "biological engineering" has been a familiar note in its pages, due largely to the frequent use of this phrase in the writings of Dr. Arno Viehoever.

activities in several departments now being co-ordinated informally there.

Food production, treatment and preservation is perhaps the most extensive field for biological engineering. Certain canned foods are now considered more suitable for consumption than the same foods "fresh" from metropolitan markets; quick freezing preserves texture, taste, and vitamins formerly lost; fruit is wrapped or coated with new materials for transportation almost unchanged to distant consumers; the butcher, the baker and the dairyman have become engineers, and in all these applications recent biological discoveries and development work are utilized.

Both bacteria and molds are today regimented under closely controlled conditions for production of industrial chemicals. Citric acid is formed by the life processes of a common black fruited mold often seen on moldy bread, but only certain strains give commercially satisfactory yields, and the exclusion of foreign strains and even of less efficient close relatives is severely enforced. This choice of most efficient strain, encouragement of birth rate, constant purge of contaminating influences caused by pervasive undesirables requires capable and ruthless administration. Even climate must be controlled in coddling the favored race.

Older art of manufacturing processes in which the primary reactions are biological may be expected to benefit materially by continued advances in applied bacteriology. The classical work of Pasteur in the wineries is known to every schoolboy. The combination of depression and failure of prohibition threw some of the best technical talent into a fresh attack on beverage technology; the contributions of the amateur radio fan to radio were imitated less spectacularly by home-brew chemists with quick-ageing processes and other proffered contributions. From anything but an amateur, however, came a special method for quick processing of wine, on which a patent is soon to issue. Wine so made probably will be taste-tested at the Patent Anniversary Dinner scheduled to be held in Washington later in the month.

Most of the present end products of commercial biological processes are liquids. The best known exception is yeast. Yeast has been used as feed, and is extracted with solvents to obtain ergosterol, which is then treated to give an important vitamin source. In August appeared one of the few papers discussing the possibilities of dry

end products of lower organisms, particularly of molds. Transparent film has thus been made experimentally, and there are suggestions that coatings, finishes, medicinals, and even food ingredients with interesting properties might thus be economically obtained. The Nostocs that grow in sugars and the slimy Oidium that pesters the paper maker are typical of the microscopic plants that might be utilized.

The production commercially of vitamin concentrates and hormones is reaching interesting proportions. Insulin was first recovered from the pancreatic gland on a practical scale by medical men, and its satisfactory production requires a thorough knowledge of biology. Manufacturing pharmacists are producing thyroxin from the thyroid gland and other hormones from similar sources, in constantly increasing quantities.

Much has appeared in the press of late on the use of electrical equipment in medicine, and such activity may be considered as included in biological engineering. Raising body temperature by inducing electrical currents within the patient himself with the "fever machine" is accepted practice, although not yet recommended for lay experimentation. Diagnosis by measurement of impedance of abnormal tissue with electrical apparatus attached to the patient is another related application. Brain waves are being studied, and it is considered possible to predict the approach of epileptic seizures. Cancer workers are using high-powered rays as possible substitutes for radium, giving a similar type of radiation with better control. Incidentally, the price of radium has dropped.

Whether certain of these activities involving a knowledge of life processes as well as the technology of other sciences will eventually be included in a curriculum for a degree in biological engineering remains to be seen. At the present time few fields offer more of active opportunity and human interest in the whole range of applied science.

ORIGINAL ARTICLES

THE QUANTITATIVE DETERMINATION OF ETHYL ALCOHOL BY A CAPILLARY RISE METHOD*†

By Floyd Todd

A Candidate for the Degree of Bachelor of Science in Chemistry, June, 1936

THE usual methods for the quantitative estimation of ethyl alcohol in aqueous solutions involve the determination of the specific gravity or refractive index of the solution. It occurred to the author that the analytical procedure and apparatus could be simplified if the combined variation of surface tension and density, as observed by a capillary rise measurement, was used as the basis for analysis. Accordingly the surface tensions of a number of hydro-alcoholic solutions were determined along with the temperature coefficients of the same solutions so that measurements at any concentration of alcohol and at any temperature could be made.

General Theory—The surface tension of any liquid as observed by the capillary rise method may be calculated from the following equation:

$Y = \frac{r\ g\ h\ d}{2}$ where Y is the surface tension of the liquid; r is the radius of the tube; g is the acceleration due to gravity expressed in dynes; h is the rise of the liquid expressed in centimeters; d is the density of the liquid. For a series of capillary tubes of varying radii and the same liquid, the value $\frac{2Y}{gd}$ is constant. This makes the height to which the liquid rises inversely proportional to the radius of the bore of the capillary tube. Hence $\frac{2Y}{gd} = C = rh$, therefore $\frac{C}{r} = h$. Since C is a function of Y and d, it varies for

*A thesis submitted to the Faculty of the Philadelphia College of Pharmacy and Science.

†An apparatus based on the "capillary rise principle" is manufactured in Germany and is sold for the alcoholometric assay of wines. But neither the author of this thesis nor any member of the College Faculty had knowledge of this apparatus when Mr. Todd's research on the capillary rise method was in progress.—J. W. STURMER.

different liquids. By using the same capillary tube the following relations may be expressed:

$$\frac{\frac{C_1}{r}}{\frac{C_2}{r}} = \frac{h_1}{h_2} \text{ , or } \frac{C_1}{C_2} = \frac{h_1}{h_2} = C_3$$

If h_2 is the height in units to which water rises in a capillary tube and h_1 is the height in units to which some other liquid will rise in the same capillary tube at the same temperature, then this ratio, C_3, is constant for the same two liquids. The h_1 is directly proportional to C_1 and the h_2 is directly proportional to C_2. Both C_1 and C_2 are constant for the same capillary tube for the same two liquids and are independent of the radius of the bore. Therefore the constant ratio C_3, which is called the "rise factor", applies to any capillary tube.

$$\frac{h_1}{h_2} = C_3 \text{ (rise factor)}$$

For the purpose of setting up rise factor tables, the height, h_2, to which water rises in a capillary tube at 20° C. has been taken as unity for the standard. The h_1 is the height to which the alcoholic solution rises in the same capillary tube at 20° C. Equations for calculating the rise factor at 20° C. when given the "rises" of the liquids at other temperatures, are included in the body of this paper.

Procedure in Brief—It is first necessary to standardize a capillary tube by noting the height to which water rises at 20° C. Once this value has been determined it is used without repeating for all subsequent alcohol determinations. Then an aqueous solution of ethyl alcohol is allowed to rise in the capillary tube at any room temperature. The tables, contained herein, are referred to in order to make temperature corrections and to determine the "rise factor" from which the per cent. of ethyl alcohol may be calculated.

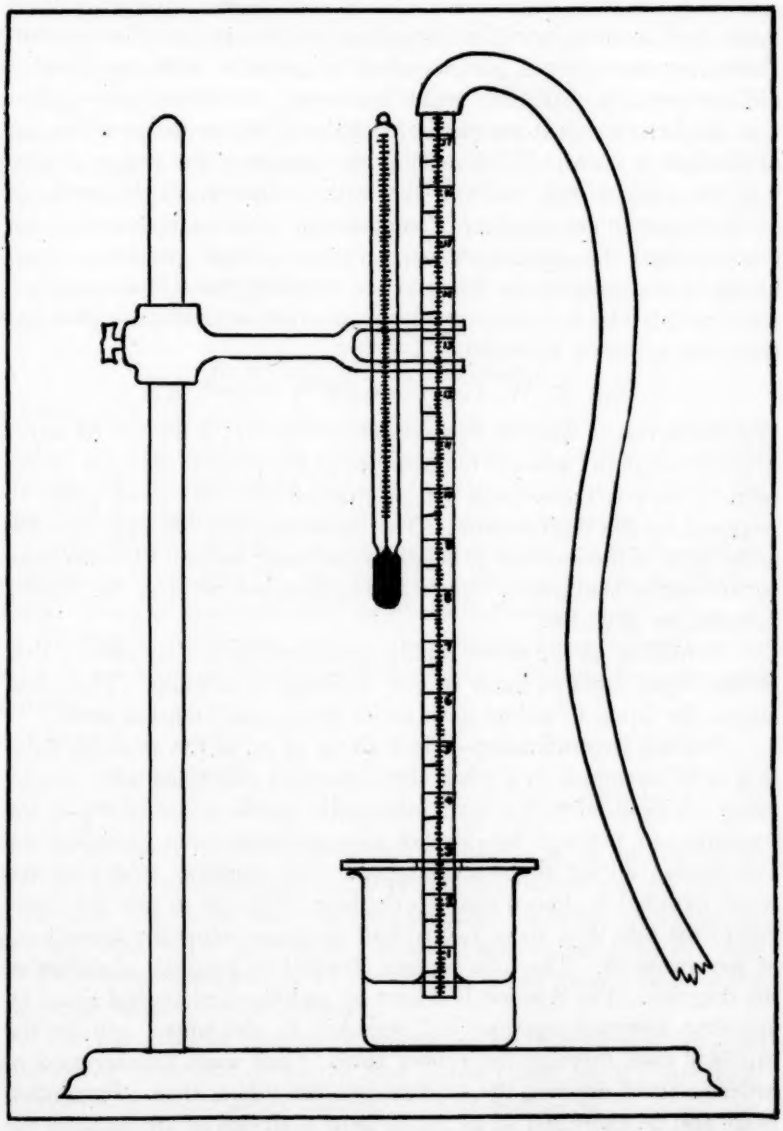
The Capillary Tube—Any capillary tube, which has a white backing and a uniform bore similar to a thermometer, may be used. The uniformity of the bore may be determined by an ocular micrometer. Also in uniform bore tubes, 95 per cent. by volume of ethyl alcohol rises only .3951 as high as water at 20° C. For most accurate readings, the diameter of the bore should be of such a size that water will rise higher than 12 cm. and not higher than 20 cm. at 20° C. This corresponds to a diameter between .0246 cm. and .0148

cm. Although liquids will rise higher in a tube of narrower bore, it is not satisfactory, since accurate check readings are more difficult to obtain. The bore does not necessarily need to be round, but the average cross-sectional area should be constant in uniform bore tubes. The outside of the tube should have accurately engraved graduations which are not more than a millimeter apart. It is not necessary to know the actual value of the divisions, since all the readings are relative. Every tenth division should be numbered and encircle the tube so that parallax errors may be avoided. The complete apparatus showing the tube is given in the accompanying illustration.

Procedure in Detail—Cleaning of Capillary Tube—The capillary tube is first cleaned by placing filtered chromic acid solution in a small clean beaker as shown in the diagram. One end of about two feet of clean rubber tubing is placed over the upper end of the capillary tube. The cleaning solution is drawn just to the top of the bore by applying suction at the opposite end of the rubber tube. Care must be exercised to prevent drawing the liquid into the rubber tube. The cleaning solution is then forced out by applying gentle pressure. This operation is repeated three or four times to clean the bore thoroughly. The same operation is again repeated using distilled water in the beaker to completely remove the cleaning solution from the bore. In order to determine whether the bore is absolutely clean, draw the water to the top of the capillary tube and allow it to drop spontaneously to its normal surface tension level. Note the reading. By applying pressure, force the water just to the bottom of the capillary tube. Then allow the water to rise to its normal surface tension level. The two levels should be exactly the same if the bore is clean.

The tube should always be kept in a container of distilled water when not in use to prevent drying and to keep the bore clean. Before using the tube for alcohol determinations, the water in the bore is removed by forcing in just enough air to displace the column of water in the bore. The expelled water is absorbed by lint-free cloth.

Standardization of Capillary Tube—In order to standardize the tube, it is necessary to use a thermometer with the bulb opposite the middle of the water column to measure the average temperature of the water in the column. Since the tube and the water within have a relatively small bulk, they soon come to the room temperature as recorded by the thermometer. Care must be taken so as not to



CAPILLARITY APPARATUS (Actual Size 5⅜ x 8⅛) FOR THE QUANTITATIVE DETERMINATION OF ETHYL ALCOHOL

breathe on the thermometer to prevent erroneous readings. As described before, the water column is allowed to rise and fall several times spontaneously until its normal surface tension level is constant. Each time the water is just expelled by pressure so as to obtain a different portion of distilled water each time. When the surface tension height remains constant, the position of the meniscus at the top of the tube is noted. When reading the bottom of the water column, it is necessary to hold the eye level with the bottom of the meniscus of the water in the reservoir container and read its position on the tube's scale. The difference of the two readings gives the actual height of the water in the tube. After recording the temperature, the water standardization constant which varies for each tube, is calculated from the following equation:

$$W_{20} = W_t \, [1 - 0.00188 \, (t - 20^\circ \text{ C.})]$$

W_{20} is the rise of water in divisions at 20° C. W_t is the rise of water in divisions at the average temperature of the column of water in the tube. The t is the average temperature of the column of water as recorded by the thermometer. The temperature coefficient, 0.00188, is the ratio of the increase in height of the water column for a decrease of one degree centigrade. Since all readings are relative, the ratio is constant for any tube.

In making all the above capillary rise readings, it is essential that at least two minutes lapse before recording a reading. This time allows the liquid to adjust itself to its true surface tension level.

Alcohol Determination—Place about 20 cc. of the alcoholic solution to be examined in a small clean reservoir container with parallel sides. A clean lid with a small hole in the middle is laid on top of the container to prevent the alcohol concentration from changing by evaporation during the determination. The capillary tube with the water expelled is slipped through the hole in the lid so that the lower end of the tube dips about two to four divisions below the lower level of the meniscus. The tube is then clamped in position as shown in the diagram. The solution is drawn up and expelled several times by applying alternate suction and pressure to the upper end of the capillary tube through the rubber tube. Care must be exercised in order to avoid drawing the solution into the rubber tube. Precaution must also be exercised so as not to blow a stream of air through the capillary tube since the more volatile alcohol would be expelled first

thus diluting the solution within the bore. This solution would again dilute the new portion of the same solution as it is drawn into the tube to produce an erroneous reading. On the other hand, the solution in the capillary tube must *just* be expelled several times in order to place a representative portion of the solution in the bore. The method for expelling the solution is to apply air pressure until all the liquid is forced out and only one small bubble appears at the lower end of the capillary tube. When the surface tension level of the solution becomes constant, as noted by several rise and fall trials, the actual rise of the solution above the lower meniscus and temperature are recorded. The approximate rise factor of the solution is calculated from the following equation:

$$\text{R. F.} = \frac{A_t}{W_{20}} \text{ (approximate)}$$

R. F. is the approximate rise factor. A_t is the rise of the alcoholic solution in divisions at the average temperature of the column of solution. W_{20} is the rise in divisions of water at 20° C. This is the calculated standardization constant previously determined.

After determining the approximate rise factor, its corresponding temperature coefficient, K, is found by referring to the rise factor tables. Since K does not vary significantly through short ranges of the rise factor, it may be used to make temperature corrections in order to calculate the exact rise factor at 20° C. from the following equation:

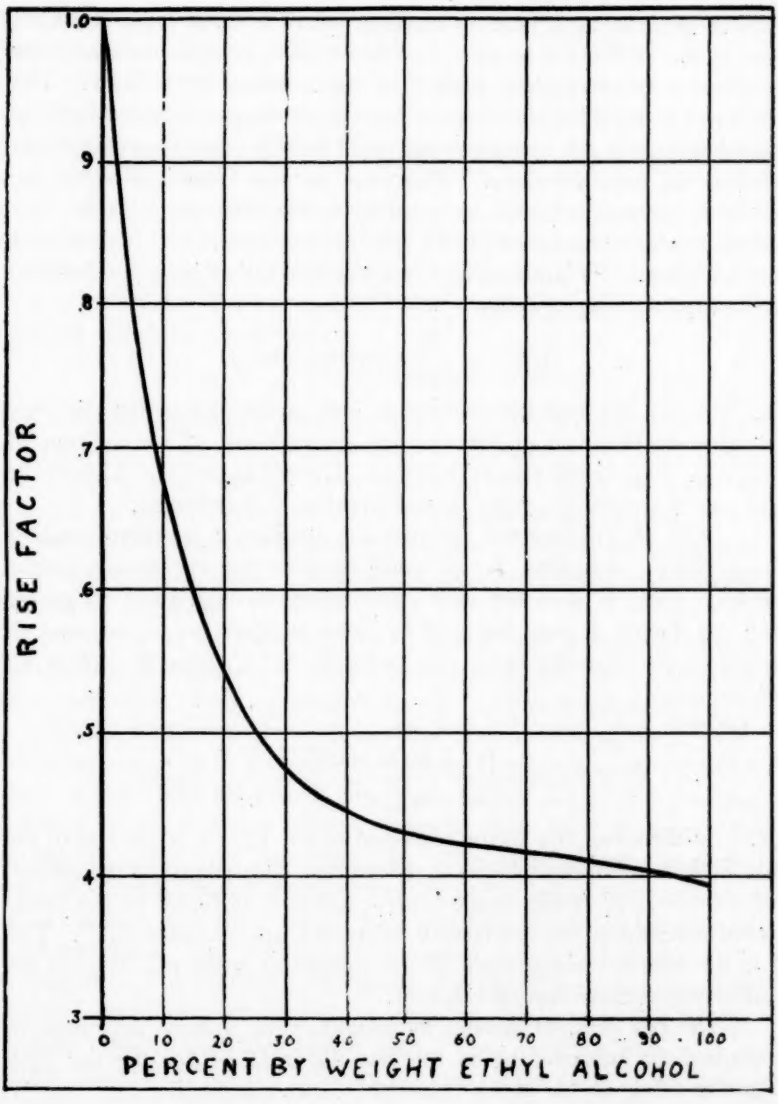
(exact)

$$\text{R. F.} = \frac{A_t\,[1 - K(t - 20°\text{ C.})]}{W_{20}} \cdot \text{(exact)}$$

R. F. is the exact rise factor corrected to 20° C. A_t is the rise of the alcoholic solution in divisions at the average temperature of the column of solution. K is the temperature coefficient as found in the tables corresponding to the previously calculated approximate R. F. The t is the average temperature of the column of solution. W_{20} is the calculated standardization constant.

The per cent. of alcohol by weight or by volume may now be obtained by interpolating in the rise factor tables for the per cent. corresponding to the above calculated exact rise factor.

Accuracy of the Determination—The sensitiveness of the capillary rise of ethyl alcohol solutions varies considerably depending on the


1.0
.9
.8
.7
.6
.5
.4
.3
RISE FACTOR
0
10
20
30
40
50
60
70
80
90
100
PERCENT BY WEIGHT ETHYL ALCOHOL

concentration as is shown in the accompanying graph. The changes in capillary rise are very sensitive for small variations of the per cent. of alcohol between 0 per cent. and 5 per cent.; sensitive between 5 per cent. and 30 per cent.; fair between 30 per cent. and 40 per cent.; and slight between 40 per cent. and 100 per cent. To obtain the most accurate results, an alcoholic solution is determined approximately by the capillary rise method. If the per cent. of alcohol is above 15 per cent., the solution is diluted one, two or three times so that the resulting concentration is below 15 per cent. The per cent. of alcohol may now be determined accurately by the capillary rise method. This per cent. of alcohol is multiplied by its dilution factor to obtain the original per cent. of alcohol.

The per cent. of ethyl alcohol of ten various concentrations were determined by the specific gravity method with the pycnometer and also by the capillary rise method contained herein. The comparison of the results is given in the following table.

Pycnometer Method % by weight	Capillary Rise Method % by weight
0.92	0.92
3.02	3.05
4.55	4.50
8.38	8.40
11.52	11.50
15.06	15.06
17.11	16.91
20.15	20.0
23.41	23.1
25.30	24.8

Effect of Contraction Due to Dilution—Whenever alcohol or its solutions are diluted with water, a contraction of volume takes place which must be considered if accurate determinations are to be made. This contraction effect is eliminated in so far as the resultant per cent. of alcohol is concerned if a definite volume of water is added to a definite volume of alcohol. When, however, water is added to a definite quantity of alcohol to make a certain total volume, then the contraction effect is significant and must be corrected for from the following data by taking proportional parts for the various dilutions of different volumes. (1.00 cc. of 100 per cent. ethyl alcohol oc-

cupies only 0.88 cc. when diluted infinitely with water.) The maximum effect of this contraction due to dilution amounts to about 12 per cent. Such extreme dilutions are not practical so that if this contraction effect is neglected, the usual error involved in making this latter type of dilution will be about 3 per cent. depending on whether the alcohol is added to the water or vice versa.

Conclusions

(1) By repeated experiments with ethyl alcohol solutions of concentrations between 0 per cent. and 15 per cent., the concentration of alcohol has been determined with an average error of 0.05 per cent. as shown by the included experimental tables.

(2) All percentages of ethyl alcohol above 15 per cent. may be determined by making the proper preliminary dilutions so that the average error may be kept at 0.05 per cent. or below.

A Typical Example.

Problem—Water rises 165.2 divisions in a capillary tube at 26° C. An alcohol solution rises 115.1 divisions at 24° C. Required to calculate the per cent. of ethyl alcohol by weight or by volume.

Solution—By using the equation for the water constant:

$$W_{20} = W_t [\, 1 - 0.00188 (t - 20^\circ\ C) \,]$$

$$W_{20} = 165.2 [\, 1 - 0.00188 (26^\circ C. - 20^\circ C.) \,] = 167.\ \text{div.}$$

By using the equation:

$$\text{R.F.} = \frac{A_t}{W_{20}};\ \text{R.F.} = \frac{115.1}{167.0} = 0.690$$

From the tables, it is found that the temperature coefficient corresponding to the rise factor of 0.690 is 0.00273. The 0.00273 is the K in the following equation:

$$\text{R.F.} = \frac{A_t\,[1 - K(t - 20^\circ C.)]}{C_{20}}$$

$$\text{R.F.} = \frac{115.1\,[1 - 0.00273\,(24^\circ C. - 20^\circ C.)\,]}{167.0} = 0.698$$

The 0.698 is the temperature corrected rise factor. By interpolating in the rise factor tables, it is found that 0.698 corresponds to 8.60 per cent. by weight or 10.63 per cent. by volume of ethyl alcohol.

RISE FACTOR TABLES OF ETHYL ALCOHOL AT 20° C.

Rise Factor	% by Weight	% by Vol.	Temp. Coef.	Rise Factor	% by Weight	% by Vol.	Temp. Coef.
1.000	0.00	0.00	.00188	0.501	25.00	29.67	.00233
0.934	1.00	1.26	.00192	0.494	26.00	30.78	.00226
0.878	2.00	2.52	.00194	0.481	28.00	33.00	.00209
0.836	3.00	3.76	.00202	0.471	30.00	35.14	.00194
0.803	4.00	5.00	.00215	0.461	32.00	37.35	.00182
0.775	5.00	6.24	.00178	0.453	34.00	39.42	.00172
0.751	6.00	7.47	.00245	0.445	36.00	41.52	.00164
0.730	7.00	8.69	.00259	0.440	38.00	43.60	.00158
0.710	8.00	9.90	.00268	0.435	40.00	45.68	.00154
0.690	9.00	11.11	.00273	0.432	42.00	47.75	.00154
0.672	10.00	12.31	.00276	0.429	44.00	49.83	.00155
0.656	11.00	13.52	.00278	0.427	46.00	51.85	.00159
0.641	12.00	14.70	.00280	0.424	48.00	53.85	.00162
0.625	13.00	15.91	.00280	0.422	50.00	55.80	.00165
0.612	14.00	17.10	.00280	0.417	55.00	60.75	.00174
0.599	15.00	18.23	.00278	0.415	60.00	65.50	.00184
0.587	16.00	19.40	.00276	0.413	65.00	70.05	.00192
0.575	17.00	20.58	.00274	0.411	70.00	74.50	.00202
0.565	18.00	21.73	.00271	0.408	75.00	79.06	.00214
0.554	19.00	22.85	.00267	0.405	80.00	83.50	.00226
0.542	20.00	24.01	.00263	0.402	85.00	87.82	.00238
0.534	21.00	25.20	.00258	0.398	90.00	92.00	.00251
0.522	22.00	26.30	.00253	0.394	95.00	96.00	.00266
0.515	23.00	27.37	.00246	0.389	100.00	100.00	.00283
0.507	24.00	28.52	.00240				

ACKNOWLEDGMENT: The author takes this opportunity to express his indebtedness to Dr. Arthur Osol for his valuable suggestions in the preparation of this paper. The writer also wishes to thank Mr. William F. Happich, Jr., who assisted in checking this new procedure.

LIGHT AND LIFE*

By Ivor Griffith, Sc. D., Ph. M., F. A. I. C.

"AND God said, Let there be light—and there was light and God saw the light—that it was good" (Gen. 1:3-4)—thus is recorded in the greatest Book of all time the alleged genesis of that form of radiant energy in the beneficence of which basks all of universe. And although we are at a loss to understand how this light could have dawned upon that first day of creation when the sun "the greater light to rule the day" according to the Scriptures, was not hung up on high until the fourth day, we must admit that this succinct genetic record is amazingly continuous and logical in many of its other premises.

Thus it states that light and water both anteceded life upon the planet, and that is fact, not fancy. Without light, without water, life could neither exist nor have its being.

Life came to this planet after water, and water came after light. Just how life came, just when, just why, no one seems to know. Only we do know that light and water are life's legitimate parents.

Visible light was first analyzed by Sir Isaac Newton, though its unvarying composition had been advertised to the world ever since the first rainbow had stretched its spectral tints in arched array.

The organs wherewith we see are not as yet evolved and involved enough to grasp all of light's components. Perhaps they never will be. There is in light a land of low visibility which the normal human eye cannot encompass. Fortunate it is that the senses of most of us have been limited by the Great Intelligence each to a narrow range.

I say "most of us" advisedly, for to a few it is given to have some special sense so highly developed as to set that individual quite apart from the average run of humans.

The cubist and the futuristic, in the field of picturization, can see things, and interpret things in such a way that only confounds the ordinary mortal. What normal being has visited an exhibition of such kind without having been made happy with normalcy. When an artist's sense of sight becomes so enamored of angles that curves hide with sudden shame, it is no wonder that what he calls his "Scene in Addis Ababa" looks to normal beings more like a score of clothes pegs dancing on a parquet floor.

*Read before the Science Teachers' Conference of New Jersey.

Yet it is a natural broadening of this same sense of vision and a kindred acuity of form and color delineation that makes a Corot or a Michael Angelo.

It is indeed an all-merciful Being that handles our dust, our doings and our destinies. As with vision, so too has the sound recording device in us been so arranged and developed that it registers only that span of tones acceptable to the organization that encompasses it. Had our ears been more sensitive to the noise of molecules, a day in a forest hearkening to atoms agog in growing trees, would set us crazy for the rest of our lives.

Listen to what Huxley, in speaking of the stirring activities going on in plant cells, says: "The wonderful noonday silence of a tropical forest is, after all, due only to the dullness of our hearing; and could our ears hear the murmur of these tiny maelstroms, as they whirl in the innumerable myriads of living cells which constitute each tree, we should be stunned, as with the roar of a big city." And whoever has heard the radio receiving set, after it catches the infinitely small electric impulses and whips them up into sounds that fill a large hall can appreciate the fullness of his statement. For sounds more silent than the farewells of ghosts can be amplified so with this new mechanism that the human ear is paralyzed with their turmoil.

But there are queer artists in tonal effects exactly as there are queer artists of form and color. For in the realm of sound interpretation, too, you will find the "musical" (?) cubists and futurists—who only see the odd angles of music and fail to get the curves and concord of sweet sounds.

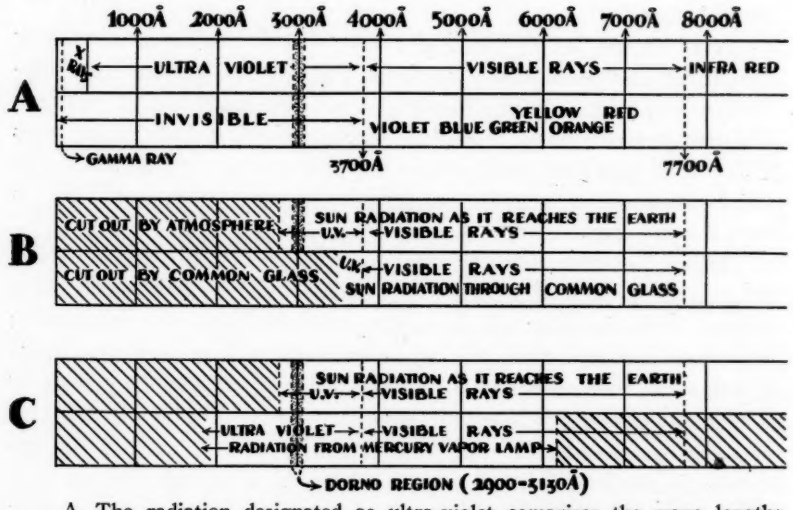
There are those who believe that without the sense of vision—without the eye, there is no color, no light, a premise quite as fallacious as believing that to one who does not own a radio set, the workaday air is not alive with democratic promises.

The broadcast is there whether or not there is a receiver, so long as the broadcasting station is on; and even where a receiver is available, unless its wave band is broad enough there will be programs, endless programs that never occur to the listener.

So with light!

Below the spectral violet with its wave lengths of some 3700 odd Angstrom units, are the busy, buzzing rays of the ultra-violet, the X-ray, the radium emanations and above, the radiant red with its 7700 odd Angstrom unit waves—are the heating waves of the infra-

red and its mile-long, undulating companions. (Note the following diagram and its explanation.)



A. The radiation designated as ultra-violet comprises the wave lengths ranging from the x-rays to the visible spectrum, which begin at about 3700 Å. The visible rays extend from this point, which is sometimes given in round numbers as 4000 Å to about 7700 Å. Then follow the penetrating infra-red rays, up to about 1400 Å, and beyond these the long-wave infra-red rays, lacking in penetrating power and known as ordinary heat rays. The ultra-violet range may be divided into three zones: The first zone, up to waves of about 2000 Å are rays at present of scientific interest rather than of practical application, but are known to be dangerous. The next zone, from 2000 Å to about 3000 Å, comprises the bactericidal rays, the germ-killing power being strongest between 2380 Å to 2490 Å. Beginning at about 2800 Å and extending to the visible violet (about 3700 Å), we have the health rays, the ultra-violet which comes to us in sunshine. From 2800 Å to 3300 Å the rays have pigmenting effect—can produce tan or freckles, depending upon the development of a skin pigment called melanin. But only the rays from 2890 Å to 3130 Å can develop vitamine D in the human skin. This is the Dorno region. Hence the rays from 2800 Å to 2890 Å and those from 3130 Å to 3300 Å can produce tan without developing vitamine D, and a transmitting medium which permits the passage of rays producing tan is not necessarily satisfactory from the health standpoint.

B. The rays of the Dorno region are filtered out of sunshine by common glass. But these rays are not necessarily shut out completely if the radiation is of great intensity as it may be had from a powerful ultra-violet lamp. The thickness of the glass must, moreover, be taken into consideration. A glass which shuts out the Dorno rays from sunshine may transmit them partially as they are emitted from a lamp.

C. Ultra-violet lamps differ not only in the range of wave-lengths which they provide, and in the intensity of total radiation, but also in the relative intensity of the wave-lengths within the Dorno region as against the other ultra-violet rays produced. Lamps are tested, compared and standardized by means of the Dorno Cadmium Cell, an electrical contrivance the construction of which is based upon the sensitiveness of cadmium to the wave-lengths from 2890 Å to 3130 Å.

(From *Science Talks*, Vol. 7, page 9.)

And diffused daylight, as well as sunlight comprises, in varying degrees, all of these radiant fractions.

The sunlight which today beams upon us as down the boardwalk we go, has taken a comparatively short time to reach us, coming at the rate of 186,000 miles a second. It takes eight minutes and twenty seconds to make the trip of ninety-three million miles from the sun to the earth. Our sun is one of the smaller suns, that is, the stars emitting light, being more condensed than some which are larger. The earth, in comparison with the sun, would be but a grain of sand at twenty-three feet from it when the sun is represented by a tennis ball; the next nearest sun, another tennis ball, would be 100 miles away. Only three suns other than our own are within ten light years of the earth, and from the nearest of them it would take four and a half years for the light to come to us. The space separating our solar system from the other suns is very great, considering the difference in time for their light rays to reach us compared with those from our sun. In fact, all life has been and is dependent on the sun as it goes on through the ages emitting radiant energy. Professor Russell says the sun will give satisfactory rays for another billion years, which relieves some of our worry.

Certain wave lengths of light are most important in both vegetable and animal life, as for instance in stimulating the chlorophyl (which is the green in plant life), the hemoglobin of blood cells (which, in thin layers, is also green), and the photosensitive plate. The ultraviolet is the most stimulating and is held by the tissues of the skin while shorter and longer waves at both ends of radiant energy pass through or are absorbed by the body. Thus red glass holds back all but the red waves of the light or visible spectrum and passes a considerable quantity of heat waves. Ultra-violet causes the cells of the skin to protect their nuclei rapidly by screening with melanin, or the so-called tan of sunburn. Such rays lower blood pressure from 7 to 10 per cent., somewhat increase the oxygen of the blood and blood calcium, the activity of endocrine glands, and the storage of iodine by the thyroid. This is of great importance as the blood carries the same fourteen primary elements that good soil does for plant life. The ultra-violet increases vitamin A; in fact can develop it in certain oils exposed to the ray. Fish liver oils, cod, halibut, sword, etc., have a large amount of this vitamin, which the fish get from the plankton which furnishes their food, and which the plankton derives from the

sun. Thus the violet ray of the sun prevents and cures rickets, which is so prevalent among the children of cities and localities befogged with smoky air, as it is approximately only for brief periods that they have much chance with old Doctor Sunshine.

The greatest effect of ultra-violet from sunlight is obtained at midday as the rays pass through the thinnest layer of air over the earth. The long slanting rays of morning and afternoon are largely screened by the air, especially because of the average half-inch layer of water diffused in vaporous form throughout the air. Thus high mountain altitudes are used in order that such sun treatments shall be most effective, although ultra-violet treatments are of value for shorter periods in any place, and artificial ultra-violet light can be created where nature gives little or no aid with sunlight. The ultra-violet which can be transmitted through air covers one and one-half octaves of light radiation, and one of the most destructive bactericidal regions of ultra-violet light is just below the very limit of the solar spectrum, that is, 2800 to 3900 Angstrom units. The ultra-violet stimulates chemical reactions without heat, which would otherwise require great heat to accomplish.

Water with carbon dioxide gas bubbling through it can be made into a carbohydrate derivative, formaldehyde, CH_2O, being formed by exposure to ultra-violet rays. Sugar is chemically but twelve parts of carbon with eleven of water. Sunlight acting on the chlorophyl of the leaf makes starch, $C_6H_{12}O_6$, while cellulose is formed by a loss of a molecule of water, as the leaf unloads its burden of starch to the tree trunk at night.

This fact of photosynthesis has long been accepted as of the vegetable kingdom. Neither chlorophyl, which develops in the chloroplasts of cells exposed to light, nor hemoglobin, the pigment which lends us our color, is produced in the absence of either iron or a similar element. One of the stated purposes of chlorophyl in the plant is to select the particular rays of light necessary in the photosynthetic processes of the plant's metabolism.

No one so far as I know has ever ventured the statement that hemoglobin or other substance in or transferrable to the animal blood may have a similar function; that the network of capillaries where this vital tissue unceasingly circulates, is so arranged as to give it the benefit of a great area of light exposure, so that it may abstract from the sunlight something which it utilizes perhaps, to produce vitamins. Has

the blood, through the medium of some constituent, a specialized affinity for certain light rays and the faculty to modify, perhaps combine with, and carry these all through the body? Indeed we do know now, that short wave irradiation does change certain substances such as carotene and certain sterols to vitamins. It is possible that irritated cells, or tissues where healing is constantly interrupted, lose their capacity for utilizing these essential light forces—that lacking the restraining forces, evil growth goes on the rampage?

'Is it possible that cancerous tissue breaks down so because the blood no longer circulates there with its wonted freedom and its usual capabilities? The frank anemia of cancer is probably an effect, but preceding it may be a blood defect much more insidious and much more subtle. Pernicious anemia may truly be a cancerous state of the blood "tissue" itself.

As tannin and kindred compounds in the plant assist in the arrest of unfavorable light vibrations, is there in blood a similar compound? Lest there be doubt of the value of tannin in this respect, let a solution of this compound (gallic acid if in water) be painted over a part of the body exposed to the violet ray. Such an area will not show a burn, whereas the unpainted surface will. The presence of tannin in the cancerous galls of the oaks and elsewhere may be a protective measure of a sort. Of course, the insect infestation of the gall must not be forgotten.

Nor are these the only manifestations of light reactions in plants, for as truly as the earth moves around the sun, so truly is the human organism, just like the plant organisms, indebted to sunlight for its life. The benefits of light are everywhere to be seen. Yet it is only recently that science has even looked in this direction.

And the by-products of this scientific search are rapidly increasing. The Finsen light, the X-ray, the ultra-violet ray, radium and its emanations, the new radio-active sodium compounds, all use that end of the spectrum apparently so vital to biologic processes. Only during the past decade have the vitamins, sunshine under pressure, been discovered. And just recently a Japanese experimenter has produced cancer in a mouse by modifying its diet and withholding certain vitamins.

Dr. Salesby, of London, has written a most interesting book on "Sunlight and Health." In it he points out that cellar-grown plants cannot produce chlorophyl nor the cellar-grown child enough hemo-

globin. The milk of cows fed on sunlit pasture is greatly superior to the milk of cows fed in the shadow. Useless codliver oil and even cottonseed oil may be activated by exposing it to sunlight or short waves of invisible light. "Making hay while the sun shines" is an axiom more scientific than sonorous. Range cattle are almost free from tuberculosis. Such are his comments.

Cancer is said to be a disease of civilization, and if that be so, truly it is because civilization has robbed our dietary of vitamins by over-grinding and over-chemicalization, by artificializing our heavily heated foods, and is still robbing our bodies of light through keeping them in the shadows of dyed garments, of city smoke, with its miasma of sooty particles, and of window glass that kills the sunshine. And it is possible that, with the current diversification of our diet and the availability of vitamins, our renaissance of eating may materially reduce this decimating scourge.

One might even go so far as to state that, outside of excision, the only cure for cancer has been accomplished through the exercise of light rays that are beyond the violet of the spectrum, such as the X-ray, the ultra-violet and the several rays of radium. Is it possible that the ray cures of cancer are due to the fact that one end of the spectrum neutralizes the effects of the other end, as acidity neutralizes alkalinity, or vice versa?

Has this any significance? If this end of the spectrum plays such an important part in biologic processes, what may be the functions of the other end, the infra-red ray and its kind?

Has cancer anything to do with light rays, with vitamins, with the pigments of the blood, that is, in a degree different from other wasting diseases? Truly these are but empiric speculations. Yet there are enough analogies between the vegetable kingdom and the human to warrant such old surmises.

"Consider the lilies of the field, how they grow, they toil not, neither do they spin." At least what spinning and toiling they do is done quietly and without ostentation. Yet were our ears attuned finely enough to hearken to the noise of molecules, and our eyes sensitive enough to catch the electric movements of the dancing atoms, we should soon know the throbbing activity among the millions of little cells that make up the modest lily.

Yes, indeed, they do spin, merrily, too, and toil without end, picking their warp from the golden sunbeams and their woof from

the warm bosom of earth. And on the loom of the lily is woven more than mere garments, more than form of flower and foliage, for her labors must also produce exquisitely delicate colors and perfume that lingers like an early love.

"Listen," said the Master, "to the lesson of the lily." Then it was spoken in parable, a delightful figure of speech. But today it is more than a parable. For the comment of the man of Nazareth is now heeded, even by men of science. The lily and all of her kin are being considered and more closely than ever before.

The dependability of the animal kingdom, notably man, upon the energy binders of the vegetable kingdom is more than ever understood, and the future holds promise of much wider information.

Likewise great similarities between these kingdoms are more appreciated.

Life holds its court in the plant not much unlike it does in the animal being, and when it leaves the temple, death comes with equal certainty. The final dissolution and the subsequent bacterial destruction of the animal frame is not different from the decay of the uprooted poplar or the cut lily. There is a circulation of vital fluid in the plant much like the blood that courses its busy way, everywhere in the human anatomy.

The fresh juices of plants behave much like this blood of the animal. Even as human blood is divided into its four agglutinin and hemolysin groups, so is there a classification for plant blood. As rabbit blood sensitized to human blood will precipitate human blood and no other (excepting the blood of apes), so also will peony juice, sensitized to lily juice precipitate only the liliaceous group and no other. The tannin of the plant cell is not greatly different in some respects from the bile of the animal.

Yes, indeed, man and the lily have much in common. Only a great difference comes in that the lily despite its evolutional changes, remains a basic being, unaltered, unspoiled and incapable of changing its own destinies.

But man, the time binder, has evolved brainward as well as in form, and his Frankensteinian brain has somewhat changed his destinies for the worse. No longer is he a basic being, but an unhealthy spoiled, convention-bound, prodigy among animals. No longer does he live close to nature as he was intended to, but he has become host for innumerable parasites, his kingdom tumbles to earth, with the

onslaught of an unicellular microscopic vegetable, and now he cringes and quails at the imminent invasion of his earth by bugs and beetles. To his credit it might be said, that he assiduously exercises his brain to combat the very misery which his overwhelming mentality has created.

And to his credit, too, goes the fact that his insistent search for the knowledge of light and life is bearing a fine fruition—though much remains to be learned, and much more to be forgotten.

Philadelphia College of Pharmacy and Science; Faculty Changes

The Philadelphia College of Pharmacy and Science has announced the following changes in the faculty, recently approved by its Board of Trustees.

Dr. Charles H. LaWall, long dean of pharmacy, and former professor of theory and practice of pharmacy, has been appointed professor of pharmacy. He retains his executive position as dean of pharmacy. Dr. LaWall is internationally known in pharmacy, as well as in analytical and food chemistry, and is regarded as one of the foremost authorities on the history of science.

Dr. Ivor Griffith, who has been associate professor of pharmacy, has been appointed assistant dean of pharmacy and assumes the position of professor of theory and practice of pharmacy. Dr. Griffith is also professor of organic chemistry at the Wagner Free Institute of Science and editor of the AMERICAN JOURNAL OF PHARMACY.

Professor Frank X. Moerk, who for over fifty years was a member of the teaching staff of the Philadelphia College, becomes emeritus director of the chemical laboratories. Doctor Arthur Osol has been appointed director of the chemical laboratories. He is associate professor of physical chemistry and assistant dean of science.

In the department of pharmacy, Dr. Adley B. Nichols has been advanced to the position of associate professor of pharmacy, and Dr. John W. McDonnell and Linwood F. Tice, assistant professors of pharmacy. Dr. Joseph W. E. Harrisson has advanced to the position of assistant director of biological assaying. He also continues as director of the Henry Leffmann Memorial Laboratory.

SCIENTIFIC AND TECHNICAL ABSTRACTS

Compiled by Linwood F. Tice, M. Sc.

Vincent's Infection. A. H. Merritt, *J. A. D. A. 23,* 2027 (1936). The author presents a full and complete review of the history, etiology, pathology, diagnosis and treatment of Vincent's infection.

The acute form is characterized by the inflammation and swelling of the gums with the formation of a necrotic membrane which can be removed, leaving a raw surface. Pain, rise in temperature and general debility occur. In the subacute form the condition existing differs only from chronic gingivitis by the sensitivity of gums to the tooth brush or dental instrument.

Two local conditions predisposing one to infection are smoking and oral sepsis. The actual infection is largely explained by self-infection, the presence of organisms in the mouth which gain a foothold due to lowered resistance.

The treatment should consist in both controlling the etiologic fusospirochetal organisms and the conditions that predispose the patient to infection. The first and most important step is dental prophylaxis without which treatment is seriously impaired. This is followed by the use of oxidizing drugs to destroy the remaining fusospirochetal organisms. Five per cent. aqueous chromium trioxide is highly recommended for this purpose in which strength it is applied on pledgets of cotton to the gums. Mouth washes are prescribed for home use. Two formulas follow:

℞

Liq. Hydrog. Perox.	℥ viii
Hydrarg. Bichlor.	gr. ii

m. ft. sol.

Sig.: Two teaspoonfuls in one-half glass of warm water, used as a mouth wash every hour the first day, three or four times daily thereafter.

℞

Pot. Permang.	gr. xx
Aquae Dist.	℥ viii

Sig.: A tablespoonful in a quarter glass of warm water, used every hour as a mouth wash.

The arsenicals do not appear to be of great value in the treatment of Vincent's infection, although good results from their local use have been reported. Intravenous medication should not be employed unless the organisms have entered the blood.

All treatment should be directed towards one end, namely, the establishment and maintenance of a high order of oral cleanliness for the purpose of reducing the number of organisms and promoting local resistance.

The Determination of Chlorbutanol. F. C. Sinton, Report in *J. A. O. C. 19,* 535 (1936). Chlorbutanol, although recognized as a monograph in the U. S. P. XI, is not provided an official assay process. A study was made of (1) Denige's method as described by Fuller (*Chemistry and Analysis of Drugs and Medicines,* p. 148) and (2) the U. S. P. method for acetone, to determine their applicability to chlorbutanol. The first method is as follows: Transfer to an Erlenmeyer flask a sample equivalent to about 0.2 gram of chlorbutanol. Add 25 cc. of 0.5 n. alcoholic potash and reflux on a steam bath for thirty minutes. Cool, and transfer to a 200 cc. volumetric flask, washing with water. Make solution acid with concentrated nitric acid and then add 5 cc. in excess. Add 50 cc. of 0.1 n. silver nitrate solution and make up to the mark with water. After shaking thoroughly pour through a dry filter, rejecting the first 20 cc. Titrate a 100 cc. aliquot with 0.1 n. potassium thiocyanate solution. 1 cc. of 0.1 n. $AgNO_3$ = 0.005915 gram of $CCl_3.COH.(CH_3)_2$. Correct for chloride in blank, if necessary. Method (2): Weigh out a sample equivalent to about 0.3 gram of chlorbutanol and transfer to a 100 cc. volumetric flask. Add water, and when solution is complete, make up to mark and shake thoroughly. To a g. s. flask add in the order named a 30 cc. aliquot, 25 cc. of a solution of sodium hydroxide (4.3 gm./100 cc.), then 50 cc. of 0.1 n. iodine solution with constant shaking, and allow to stand fifteen minutes. Make acid with 16 cc. of 10 per cent. hydrochloric acid and titrate the residual iodine at once with sodium thiosulfate solution, adding starch as indicator when the liquid is nearly decolorized. Conduct a blank test with the same quantities of the reagents and subtract the quantity of iodine solution consumed in the blank test from that used in the assay. Each cc. of 0.1 n. iodine corresponds to 0.00296 gm. of $CCl_3.COH.(CH_3)_2$.

Method (1) seems to be entirely satisfactory whereas in method (2) variation in order and time of adding various solutions produced quite variable results. It is recommended that method (2) only be used as a supplementary method. If analysis is made by both methods and the results check, the evidence strongly indicates chlorbutanol.

The Effect of Degree of Comminution on Extraction by Percolation of Belladonna Leaf, Ipecac and Stramonium. A. W. Bull, *Quart. J. Pharm. & Pharmacol. 9,* 347 (1936). Various sized powders of these drugs were prepared and percolated with a mixture of nine parts of 90 per cent. alcohol and one part of water, in the case of belladonna leaf; 90 per cent. alcohol in that of ipecac, and 45 per cent. alcohol for stramonium.

A summary of results is tabulated below:

Belladonna Leaf.

1. The yield of total extractive increases as the powder size decreases.

2. The alkaloidal yield varies in the same way.

3. The relative proportion of alkaloid to total solids is greatest in the extract from the 22/60 powder and least in that from the 85 powder.

4. The alkaloids are extracted more quickly than are the other soluble constituents of the drug.

Ipecac.

1. The yield of total extractive increases as the powder size decreases.

2. A moderately fine powder 44/85 gives a better alkaloidal yield than either a fine powder or a moderately coarse.

3. The per cent. of alkaloids in the total extractive is greatest in that from the 44/85 powder.

4. The phenolic alkaloids are extracted by alcohol (90 per cent.) more quickly than are the non-phenolic type, and after a time practically all the alkaloids in the marc are non-phenolic.

Stramonium.

1. A fine powder, 85, yields more total extractive and total alkaloids than does a moderately coarse powder, 22/60, which in turn gives a greater yield of both than does a moderately fine powder, 44/85.

2. The proportion of alkaloids to total extractive is most in the 22/60 powder and least in the 44/85 powder.

3. The alkaloids are extracted more quickly than is the total extractive of the drug although in the early stages of the percolation the reverse is the case.

The Anomalous Viscosity of Mucilage of Tragacanth. G. Middleton. *Quart. J. Pharm. & Pharmacol. 9.* 493 (1936). It has been shown that tragacanth mucilage, like many other lyophilic colloidal solutions such as those of starch, agar, gelatin and nitrocellulose, does not show a true viscosity independent of the rate of flow but has the property of "anomalous" or "variable" viscosity, i. e., the ratio between applied pressure (rate of shear) and rate of flow is not constant, but decreases rapidly as the rate of shear increases. It is therefore impossible to express the viscosity of a tragacanth mucilage by any single figure, but the conditions under which it has been determined must also be specified. Inasmuch as with liquids of anomalous viscosity the measurement must be made under conditions of constant flow and rate of shear, the falling sphere method was chosen. Since the effect of heat on the mucilage was to be studied the gum was soaked for a prolonged period in water after which it was passed several times through a gauze or wire screen (about thirty-six mesh) in order to produce a uniform mucilage. After straining the mucilages were allowed to stand overnight. Then their temperature was adjusted to 20° C., the bottle evacuated, and shaken vigorously. After standing for five minutes air was admitted to the bottle, and the tube of the viscosimeter filled by allowing the liquid to run down the sides of the tube in such a way that no bubbles of air were entrapped, while the air in the narrow portion of the tube was allowed to escape by momentarily opening the tap. A centralizing tube was inserted in the top of the tube and the whole apparatus leveled. A steel ball (one-eighth inch, wt. 0.1295 gm.) was placed in the top of the centralizing tube from whence it passed

into the graduated tube. The mean time required to fall 5 cm. was measured.

It has previously been observed (Quart. J. Pharm. & Pharmacol. 7, 492 (1934)) that if two successive balls are allowed to follow the same path through a mucilage of tragacanth, the second one falls more rapidly than the first. It was found that after the first or second ball the time became approximately constant. This was shown not to be due to thixotropy but to an orientation of the particles with relation to, and probably along, the axis of the tube, so facilitating the passage of the second ball. This phenomenon may be termed "Stream Orientation." In reading the time required for the sphere to fall the constant value obtained after the first or second ball was taken.

The viscosity was found to decrease with increase in temperature, passing the mucilage through very fine channels increased its viscosity. Heating the mucilage at 100° C. for from one to fifteen minutes produced a marked gain in viscosity but a big drop resulted after heating for one hour. At 70° C. it required about eight hours to attain the same maximum while at 50° C. more than twenty-four hours are required to develop the full viscosity. Ageing the mucilage produced a marked rise in viscosity, such increase extending over a considerable period of time and taking place even when the mucilage had previously been subjected to treatment which increased its viscosity. Powdering tragacanth greatly impairs its viscosity.

Based upon the information outlined above, the author, in a second article, *The Standardization of Tragacanth* gives a detailed method for evaluating tragacanth gum which it is believed is an important contribution towards a better control of this most variable drug.

The Adsorptive Capacity of Charcoal. B. S. Sjögren and E. Walldin, *Svensk. Farm. Tidsskr. 39,* 617 (1936), through *Quart. J. Pharm. & Pharmacol. 9,* 570 (1936). The adsorptive capacity of charcoal is generally tested against methylene blue, antipyrin, mercuric chloride or iodine; phenol, benzoic acid, pyramidon, resorcin strychnine and morphine have also been suggested. The results of tests with different compounds are not always parallel, but those obtained with methylene blue and antipyrin are comparable with one another, as also to some extent are those with mercuric chloride and

iodine. It should therefore only be necessary to test charcoal with one of each of these pairs of substances. The best method is that in which excess of the compound is added and the excess is determined after a certain period of time. This is more conveniently carried out with antipyrin than with methylene blue. Mercuric chloride is not a suitable compound for testing charcoal as it has been shown that it is partially reduced to calomel. Medicinal charcoal may be assayed biologically by determining its effect in reducing the toxicity of strychnine to guinea pigs, but this offers no advantage over a chemical determination of the adsorption of strychnine which gives similar results. The strychnine adsorption is not, however, necessarily parallel to that of antipyrin or iodine and it is therefore desirable that tests should be carried out on all three of these substances. In the case of tablets of charcoal, the adsorptive capacity may be affected by binding material in the tablets; those prepared with dextrin, for example, still show a high adsorption for methylene blue, antipyrin and iodine, but a greatly reduced adsorption for strychnine. In determining the strychnine adsorption, 0.2 gm. of the charcoal is shaken for five minutes with 50 cc. of a 0.5 per cent. solution of strychnine nitrate and centrifuged. The strychnine in the clear liquor is then determined by shaking out 10 cc. of it with ammonia water and chloroform, and titrating the alkaloidal base.

The Determination of Iodine and Bromine in the Presence of Each Other. L. Spitzer, *J. Ind. & Eng. Chem. Anal. Ed. 28,* 465 (1936). Utilizing the difference in oxidizing power between bromine and iodine towards formic acid and formates it is possible (1) to determine the amounts of iodine and bromine in a mixture. (2) to determine iodide in the presence of bromide. The method for the former analysis consists in adding sodium formate to an aliquot portion of the solution of iodine and bromine; after the bromine has been reduced to bromide (about ten minutes) the iodine is titrated with sodium thiosulfate. Potassium iodide is added to a second aliquot portion of the solution and the total iodine is titrated with thiosulfate. The quantity of bromine may be calculated from the difference between the two titrations. In the case of mixtures of bromides and iodides, the iodine is liberated by adding bromine; the excess of bromine is reduced by adding sodium formate solution and the iodine is then titrated with thiosulfate.

A Sensitive Method for the Estimation of Metacresol. Wada and Kawai, *J. Soc. Chem. Ind. Japan,* 1362 (1935), through *Pharm. Zentralhalle 77,* 619 (1936). One gram of cresol is weighed into a flask and to it are added 2 cc. of fuming sulfuric acid and the mixture shaken until solution is effected. Then one adds quickly 12 cc. of concentrated nitric acid to it and heats the flask on a water bath. When brown fumes no longer escape, the solution is placed in a dish containing 10 cc. of water. After standing two hours crystals of trinitrometacresol separate upon rubbing the dish. These are filtered out, dried at 95 to 100° C. and weighed. Each gram of trinitrometacresol = 0.56 gm. of metacresol.

A New Method for the Determination of Vitamin C. Martini and Bousignore, *Bol. Soc. it. Biol. sp.* 399 (1934), through *Pharm. Zentralhalle 77,* 582 (1936). A weighed sample of about 0.5 gm. of the substance to be tested and 8 cc. of water with 0.2 cc. of methylene blue solution (1:10,000) are placed either in sunlight or under an ultra-violet lamp. In the presence of ascorbic acid the solution is decolorized. Then an amount of the methylene blue solution is added until its color after being placed in the light is just equivalent to a blank. The number of cubic centimeters of methylene blue solution required may be used to calculate the ascorbic acid content of the sample since 1 cc. of the methylene blue solution = 0.0047 mg. ascorbic acid.

SOLID EXTRACTS

By Ivor Griffith, Ph. M., Sc. D.

Glass, which now bids fair to be displaced by the colorless plastics, is an ancient invention, and is known to have existed for over six thousand years.

At the Roman conquest of Egypt, in 23 B. C., glass making was so advanced that Caesar Augustus ordered the conquered people to pay a large part of their tribute in the form of glass. The Romans were immediately delighted with these new wonders; soon they induced Egyptian craftsmen to come to Rome, and thus glass making was transplanted to the Imperial City. Invention of the blow pipe followed shortly after, causing a complete transformation in the form and appearance of glass, and the industry developed so rapidly that glass became almost commonplace. Window glass first appeared in the third century B. C.

Country lads have known for ages the trick of catching a handful of glow-worms, enclosing them in a flimsy lantern of perforated paper there to exhibit their weird flashes of luminous rays.

But country lads hardly knew the nature of the firefly's light, which we now call "a bioluminescent reaction." Nor did they suspect that the efficiency of this light is 100 per cent. insofar as light within the visible spectrum is concerned and that it is essentially a "cold light", twenty-five times more efficient than any artificial illumination.

"You can't make a silk purse out of a sow's ear" is another proverb thrown into the discard by science. At a recent "research parade" a beautifully garbed young woman, dubbed the "Maid of Science" carried a rare historic object—a silk purse made from sows' ears. A great chemist, Arthur D. Little, in 1921 actually gathered up the ears of sows, made gelatine of them, and by a process similar to that of producing rayon, the threads were spun and dyed. This green and rust colored silk was knitted into a form of purse such as medieval ladies once carried.

The little purse is more than a stunt, it is a symbol. By making that purse, modern science defied the age-old impossibilities: "You can't make a silk purse from a sow's ear."

There are no sows' ear purses on the market; there are other sources of silk much better for our use. But the moral remains: If a problem in science is sufficiently interesting, the worker in pure science will solve it.

Soil cooties, that keep the earth in constant itch, are far more prevalent than most of us believe. The earth is fairly alive with them, and their role in aerating the soil and in activating the anchorage of earth's green children is an exceedingly important one.

Even in the coldest days of winter these myriad animalcules are busy setting the stage for the parade of grain and fruit and flower that comes with warmer seasons. Striking new figures on how much life there is in seemingly dead soil have been produced by Dr. G. Frenzel of the Breslau Zoological Museum. He made a count of a number of soil samples taken at the depth of about a foot, in rather dry, sandy meadowland. Of one-celled animals he found nearly 150 million per square yard, and of many-celled forms, principally small insects and mites, approximately 90,000. Bacteria and other forms of plant life were not included in his count.

Yet we *do* remember, how, although we knew that hosts of earthworms undulated in our garden soil, our search for them, when the speckled trout or calico bass craved vermiform appendages, was more than often, a futile, foolish search.

Although, in most sea waters, magnesium is present only to the extent of about a teaspoonful to the gallon (0.01 pound per gallon) it is often more economical to extract it from that source than from its land-locked estate, where it is present in much more generous amounts, (dolomite 12 per cent., magnesite 28 per cent. and brucite 41 per cent.).

The Dead Sea, which is dead only in name, is buzzing with activity. British chemists and engineers extracting from it unbelievable amounts of potassium and magnesium.

Milk of magnesia from sea water sounds a bit far-fetched but that popular antacid is now being prepared almost directly from its marine origin.

The hazards of urban existence are not just due to speed maniacs, toppling scaffoldings and slant-shooting scallywags. City-soot

is now indicted. According to *Science News,* soot-laden city air may be causing cancer of the lungs in the inhabitants of cities. Conclusive evidence for this is lacking, but strong circumstantial evidence is brought forward in a recent report to the *American Journal of Cancer* (September).

Figures from the U. S. Census Bureau show that lung cancer deaths are more numerous in cities than in rural areas. The relation between the greater number of deaths and the greater amount of soot in the air is close enough, the article states "to warrant more activity on the part of public health authorities in the various anti-smoke campaigns."

The tar in soot and the way soot invades all the structures of the lungs make it capable of causing cancer. Tar itself has long been recognized as a cancer-causing substance. Tar painted onto the skin of mice causes cancer. Whether or not tar, breathed into the lungs with sooty air, could cause cancer, as the death statistics suggest, was the problem the authors of the article set out to solve.

For mice apparently it can and does, which strengthens the assumption that it does also in the case of man.

In a group of mice that lived in a sooty atmosphere over a long period of time, eight out of a hundred developed lung cancer. By contrast, two out of a hundred developed lung cancer in a group that lived in a soot-free atmosphere. The soot was secured by sweeping the flue of the hospital furnace which burns Kentucky bituminous nut coal.

The smoke menace is therefore not one to disturb our esthetic ideas, but much more seriously, our health and comfort.

Chemiluminescence is the production of light during low temperature chemical reactions. Within the past year, a new organic chemical has been synthesized and found upon mild oxidation with potassium ferricyanide and hydrogen peroxide in the presence of sodium hydroxide to glow brighter than any previously prepared artificial or natural substance. It is far superior to luciferin in this respect. The originators call it "luminol" because of its light-giving properties and the enolic nature of its chemical constitution. It is 3-amino phthalhydrazide, and is an exceedingly interesting substance, in spite of the fact that it has, as yet, found no practical use.

INDEX TO VOLUME 108 OF THE AMERICAN JOURNAL OF PHARMACY

AUTHORS, 1936

(B)—Book Review
(E)—Editorial

TITLE AND SUBJECT INDEX FOR 1936

(A)—Abstract
(B)—Book Review
(E)—Editorial
(S)—Solid Extract